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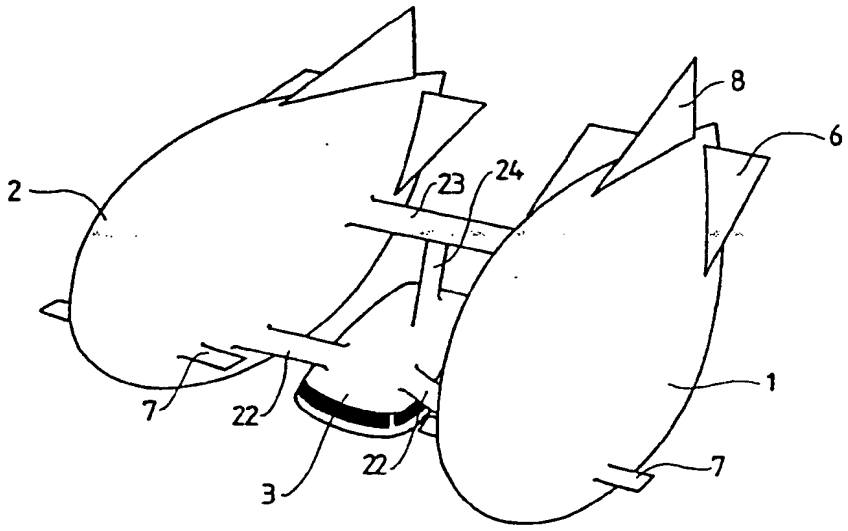
(54) Title: IMPROVED AIRSHIP



(57) Abstract

An airship comprises two substantially parallel, spaced apart and semirigid hulls (1, 2) adapted to contain a lifting gas, a gondola (3) is connected to the hulls (1, 2), and a drive means is provided to impart vertical lift to the airship. A drive means adapted to impart horizontal motion to the airship may also be provided. Each hull (1, 2) includes a framework comprising two semirigid circumferential bands which are interconnected by a plurality of longitudinal strips and a plurality of radially extending spokes. Support means (22, 23, 24) interconnect the circumferential bands of each hull (1, 2) to the gondola (3). Each hull (1, 2) consists of an outer covering enclosing a number of gas containing cells. The hulls (1, 2) are longer than their width and wider than their height and in cross-sections they have a shape approximate to that of an aerofoil. Ventrally as compared to dorsally the hulls (1, 2) are substantially flatter. Vertical fins (8), tail planes (6), forward stabilizers (7) are provided to assist in the overall manoeuvrability and stability of the airship.

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IMPROVED AIRSHIP

The present invention relates to improvements in air-ships, being load-carrying means which derive their lifting power from aerostatic forces rather than the aerodynamic forces such as those that support a conventional aeroplane (fixed-wing craft). With such air-ships the lift is one of buoyancy, being derived from the differences which exist between the density of the atmosphere and that of a lifting gas contained by the air-ship itself.

With prior art arrangements the size of an air-ship is primarily, if not exclusively, determined by the actual volume of lifting gas required to lift the relevant payload (weight of the ship and its associated load, be it personnel and/or equipment). Air-ships have in the past been equippped with a propulsive means for controlling the attitude, speed, altitude and course and this in marked

contrast with what might be termed a free balloon, for which only altitude is effectively controllable, with velocity and direction of movement being dependent largely upon the vagaries of the wind/elements. The requirements of navigability and aerodynamic efficiency have caused an effective aerodynamic shape to be given to an air-ship, this shape being circular in cross-section, with a rounded nose and a tapering tail. With the known arrangements propulsion has been obtained from air propellers driven by, for example, internal combustion engines which are either mounted in nacelles attached to a hull or to a gondola or which are located within the hull and which drive propellers by means of shafts and gearing extending through a skin of the hull itself.

The prior art arrangements have suffered from a number of disadvantages, in terms of their efficiency and effectiveness of operation. By way of example, the prior art arrangements have been found to necessitate an inordinately large hull size for any reasonable payload. Furthermore experience has shown that known or conventional types of air-ship suffer in terms of their controllability, manoeuvrability, stability etc. Indeed air-ships of the type currently now being re-introduced into service require constant trimming, etc. by the crew in order to maintain any sort of acceptable attitude, an on-going exercise which is extremely wearing on the crew. Furthermore such air-ships need a substantial number of crew for purposes of landing, take-off etc.

The present invention seeks to at least partly overcome one or more of the problems and disadvantages associated with prior art air-ships and to provide a form of air-ship which is readily controllable and

manoeuvrable, capable of transporting substantial loads (personnel and/or plant) if required, eminently suitable for a variety of applications and is in fact effectively stable and controllable in most weather conditions.

The present invention provides an airship comprising two substantially parallel and spaced apart hulls adapted to contain a lifting gas, a gondola connected to the hulls and a drive means adapted to impart vertical lift to the air-ship.

Preferably there are two such drive means laterally spaced from one another with respect to the gondola.

Preferably there is a drive means adapted to impart horizontal motion to the air-ship.

Preferably the hulls are longer than they are wide and in longitudinal cross-section have a shape approximating to an aerofoil whereby in use to provide vertical lift during forward motion in consequence of that aerofoil shape.

Preferably the hulls are wider than they are high.

Preferably ventrally as compared to dorsally the hulls are substantially flatter.

Preferably each hull is provided with an upwardly extending generally vertical stabilizer fin adjacent a rear end thereof.

Preferably said generally vertical stabilizer fin or part thereof is variable in attitude.

Preferably each hull is provided with a laterally extending generally horizontal stabilizer fin adjacent a rear part thereof.

Preferably said generally horizontal stabilizer fin or part thereof is variable in attitude.

Preferably each hull is provided with a laterally extending generally horizontal stabilizer fin adjacent a forward end thereof.

Preferably said generally horizontal stabilizer fin adjacent a forward end is variable in attitude.

Preferably the gondola is provided with landing wheels.

Preferably each hull comprises an outer covering enclosing a number of gas containing cells.

Preferably the covering additionally encloses a number of normally empty cells into which gas may be passed from said gas containing cells to thereby relieve pressure in said gas containing cells.

Preferably there is pressure responsive valve means adapted to open under a predetermined pressure to allow gas to pass from said gas containing cells to said normally empty cells.

Preferably there is pump means for pumping gas from said normally empty cells to said gas containing cells.

Preferably there is a framework comprising circumferential bands extending around the hulls, spacer members extending between said bands and spacing the hulls apart and suspension members extending from one of the spacer members and said bands and suspending the gondola.

In one instance the framework additionally comprises a generally centrally extending keel within each hull and connector members extending from said keel to said bands.

Preferably there is a plurality of generally radially extending members extending from said keel and supporting longitudinally extending stringer members.

In another instance the framework additionally comprises a plurality of generally radially extending members supporting longitudinally extending stringer members.

Preferably the radially extending members support circumferential members.

In order that the invention may be more clearly understood and put into practical effect reference will now be made to a preferred embodiment of an air-ship in accordance with the invention. The ensuing description is given by way of non-limiting example only and is with reference to the accompanying drawings, wherein:

FIG. 1 is a perspective view from above of a preferred embodiment of an air-ship in accordance with the invention;

FIG. 2 is a perspective view from below of the embodiment of FIG. 1;

FIG. 3 is a perspective view of a gondola for an air-ship in accordance with the invention;

FIGS. 4A and 4B are views of alternative embodiments of gondola;

FIG. 5 is a side elevational view of a hull for use in a preferred embodiment of an air-ship in accordance with the present invention;

FIG. 6 is another side elevational view of a most preferred hull showing certain constructional features;

FIG. 7 is a longitudinal cross-sectional view of the hull of FIG. 6;

FIG. 8 is a lateral cross-sectional view of the hull of FIG. 6; and

FIG. 9 depicts cross-sections at various stations marked on Figures 6 and 7.

As illustrated an air-ship in accordance with the present invention includes two separate and interconnected hulls 1 and 2, this in marked contrast to known air-ships, which employ or use one hull and one hull only. Experimentation has shown that it is this single hull concept which in itself contributes to the lack of stability exhibited by known air-ships. The twin-hull arrangement as now envisaged by the present applicant is responsible for a remarkable improvement in stability, controllability and manoeuvrability of the relevant air-ship. More particularly the twin-hull arrangement as now proposed affords predictable controllability, seemingly by reason of improved air flow around the twin hulls. In a practical sense the twin-hull arrangement can also be said to provide improved lift capability.

In one preferred arrangement each hull 1, 2 is constructed from kevlar (trade mark) and 6-layer

co-extruded plastics material laminate. The arrangement in accordance with the present invention preferably employs semi-rigid hulls, in other words hulls wherein the shape of each hull 1, 2 is to a certain extent maintained by gas pressure but where there is also provided a structural keel extending longitudinally from the nose to the tail, with perhaps additional structural reinforcement at the nose and at the attachment of the control surfaces. The frame-work may be constructed, preferably, of a number of girders running longitudinally of each hull connected by parallel-disposed substantially circumferential rings. The circumferential rings should preferably be substantially rigid. In an alternative embodiment, however, diametric braces may be employed in order to ensure a self-sustaining shape for each hull.

The respective hulls can be interconnected in any convenient manner and in turn are connected, again in any convenient manner, to a gondola 3. In the preferred embodiments illustrated the gondola 3, affixed or connected to the twin hulls 1, 2 in any suitable manner, in itself will be of an appropriate aerodynamic shape whereby if not so much to assist, at least not to inhibit, lift of the overall structure. Furthermore, the gondola can be so designed as to have viewing ports at both front and rear, not to mention along the sides, whereby to provide effectively 360° comprehensive viewing, this in marked contrast to gondolas in use on existing air-ships of conventional design. The gondola 3 can be of a suitable size to suit the intended usage for the air-ship. By way of example, a large-scale gondola 3 could be employed if the air-ship is to be used for ferrying or carting substantial numbers of personnel or quantities of plant and the like equipment.

Alternatively, if the air-ship is to be used for purposes of tracking or surveillance, then smaller sized hulls 1, 2 and gondola 3 could be employed.

In accordance with known practices the air-ship in accordance with the present invention will include means allowing for forward or rearward propulsive movement or drive. In the embodiments illustrated such means could take the form of at least one, and preferably two, engines 4 preferably of the internal combustion type appropriately located and housed on or within the gondola 3 itself. In an especially preferred embodiment two Porsche high-speed by-pass engines can be employed for purposes of providing propulsion efficiency. Such engines, in conjunction with the asymmetric design of the hulls themselves, can be responsible for markedly improved efficiency of forward and rearward movement as desired.

Preferably the arrangement in accordance with the present invention will have means allowing for vertically upward or downward movement as conditions require. In the arrangements illustrated such a result can be achieved by the provision of one or more vertical lift engines 5 appropriately disposed on the gondola 3, again appropriately housed, in any convenient manner, on or within the gondola 3 itself. Such vertical lift engines 5 afford a substantial improvement over known air-ships, wherein lift was dependent solely upon the size of the hulls and the nature of the gas retained therein. In this regard it should be realized that there can sometimes be expected to occur situations wherein rapid vertically upward or downward movement is required, and the provision of the vertical lift engines 5 is responsible for such a capability in the present applicant's arrangement. By way

of example, if the air-ship is being used for purposes of surveillance in or over a combat zone, it may sometimes be extremely desirable to quickly gain altitude, whereby to lift the air-ship out of range of stray bullets, shells or other armament. Alternatively, when an air-ship in accordance with the invention is being used in a rescue situation, it may be desirable to lose altitude quickly - as for example to pick up injured personnel - and then to gain altitude with a view to safe travel.

The arrangement in accordance with the present invention furthermore preferably includes vertical fins 8 and tail planes 6 intended to assist in overall manoeuvrability and stability. There are also provided forward stabilizers, generally designated 7, intended to assist in controlling the attitude of the craft even in high winds. Indeed the provision of such stabilizers 7 will afford the craft the capability of being able to turn in effectively its own width and to perform non-banked turns.

Retractable landing gear 9 may be provided.

The arrangement in accordance with the present invention will be responsible for a number of significant advantages when compared with prior art dirigibles or air-ships, as set out hereinafter in more detail.

Principally the arrangement in accordance with the present invention is responsible for a remarkably stable air-ship, and more importantly an air-ship which exhibits a remarkable degree of controllability and manoeuvrability, thereby lending itself to usage in a variety of circumstances, civil, commercial and even military. Secondly, and by reason of the overall shape of

the hulls and the gondola the operating costs in terms of both fuel and maintenance could be expected to be rather low, being as little as 15% of the cost of most existing conventional fixed-wing aircraft or helicopters. By its very nature the air-ship in accordance with the present invention would also be significantly quieter in its operation when compared to such fixed-wing aircraft or helicopters.

In perhaps a more practical sense an air-ship in accordance with the present invention would be capable of remaining airborne for a substantial period of time. Indeed the factors governing the duration of any flight would be the need for replenishing food, water and fuel supplies.

The air-ship in accordance with the present invention lends itself to usage in a variety of contexts and situations, for example as a mere personnel or freight carrier, for purposes of surveillance and rescue (over land or sea and by day or night), for military purposes (when appropriately armed), for tracking purposes, for patrolling State borders or territorial waters and coast-lines.

Reference is now made to FIGS. 6-9 which show in some detail some particularly preferred aspects of a preferred hull 19.

As shown in FIGS. 6-9, the hull 19 comprises two semi-rigid circumferential bands 20 and 21.

The band 20 is connected to the gondola 3 by a support member 22 and the gondola is further connected by another such support member to another such hull (not shown).

The band 21 is connected to that other such hull by a connector member 23 and that connector member is connected to the gondola 3 by a support member 24.

Extending between the bands 20 and 21 and to the nose 26 and tail 27 of the hull is a plurality of longitidinal stringers 28. The stringers are supported intermediate the bands 20 and 21 and adjacent the nose 26 and tail 27 by a plurality of generally radially extending spokes 29 which are adjusted in length to give the shape desired.

The shape of the hull 19 is to be noted and can be best conceived from the sections shown in FIG. 9.

In general, the hull 19 is broader in cross-section than it is high, is relatively flat in the ventral region 31 as compared to the dorsal region 32 and in longitudinal cross-section as shown in FIG. 7 has the general form of an aerofoil.

Thus, it is believed that the shape of the hull will have a material effect on the overall stability of the air-ship with respect to roll and pitch and the general aerofoil shape should generate lift which may be of material assistance in certain adverse conditions or in times of emergency.

Within the hull 19 are primary gas cells 43-48 which will contain lifting gas and slave cells 41, 42, 49 and 50.

The slave cells are connected to the primary cells by pressure responsive valves 52 which may be used to reduce any excess pressure in the primary cells as the

air-ship rises by passing gas to the slave cells which, at sea level, will be normally empty. Pump means may be provided for pumping gas from the slave cells to the primary cells.

The described arrangement has been advanced merely by way of explanation and many modifications may be made thereto without departing from the spirit and scope of the invention which includes every novel feature and combination of novel features herein disclosed.

CLAIMS:-

1. An air-ship comprising two substantially parallel and spaced apart hulls adapted to contain a lifting gas, a gondola connected to the hulls and a drive means adapted to impart vertical lift to the air-ship.

2. An air-ship as claimed in claim 1, wherein there are two such drive means laterally spaced from one another with respect to the gondola.

3. An air-ship as claimed in claim 1 or claim 2, and including a drive means adapted to impart horizontal motion to the air-ship.

4. An air-ship as claimed in any preceding claim, wherein the hulls are longer than they are wide and in longitudinal cross-section have a shape approximating to an aerofoil whereby in use to provide vertical lift during forward motion in consequence of that aerofoil shape.

5. An air-ship as claimed in any preceding claim, wherein the hulls are wider than they are high.

6. An air-ship as claimed in any preceding claim wherein ventrally as compared to dorsally the hulls are substantially flatter.

7. An air-ship as claimed in any preceding claim, wherein each hull is provided with an upwardly extending generally vertical stabilizer fin adjacent a rear end thereof.

8. An air-ship as claimed in claim 7, wherein said generally vertical stabilizer fin or part thereof is variable in attitude.

9. An air-ship as claimed in any preceding claim, wherein each hull is provided with a laterally extending generally horizontal stabilizer fin adjacent a rear end thereof.

10. An air-ship as claimed in claim 9, wherein said generally horizontal stabilizer fin or part thereof is variable in attitude.

11. An air-ship as claimed in any preceding claim, wherein each hull is provided with a laterally extending generally horizontal stabilizer fin adjacent a forward end thereof.

12. An air-ship as claimed in claim 11, wherein said generally horizontal stabilizer fin adjacent a forward end is variable in attitude.

13. An air-ship as claimed in any preceding claim, wherein the gondola is provided with landing wheels.

14. An air-ship as claimed in any preceding claim, wherein each hull comprises an outer covering enclosng a number of gas containing cells.

15. An air-ship as claimed in claim 14, wherein the covering additionally encloses a number of normally empty cells into which gas may be passed from said gas containing cells to thereby relieve pressure in said gas containing cells.

16. An air-ship as claimed in claim 5, and including pressure responsive valve means adapted to open under a predetermined pressure to allow gas to pass from said gas containing cells to said normally empty cells.

17. An air-ship as claimed in claim 15 or claim 16 and including pump means for pumping gas from said normally emty cells to said gas containing cells.

18. An air-ship as claimed in any preceding claim, and including a framework comprising circumferential bands extending around the hulls, spacer members extending between said bands and spacing the hulls apart and suspension members extending from one of the spacer members and said bands and suspending the gondola.

19. An air-ship as claimed in claim 18, wherein the framework additionally comprises a generally centrally extending keel within each hull and connector members extending from said keel to said bands.

20. An air-ship as claimed in claim 19, and including a plurality of generally radially extending members extending from said keel and supporting longitudinally extending stringer members.

21. An air-ship as claimed in claim 18, wherein the framework additionally comprises a plurality of generally radially extending members supporting longitudinally extending stringer members.

22. An air-ship as claimed in claim 21, wherein the radially extending members support circumferential members.

23. An air-ship substantially as hereinbefore described with reference to any one of the accompanying drawings.

24. The steps or features disclosed herein or any combination thereof.

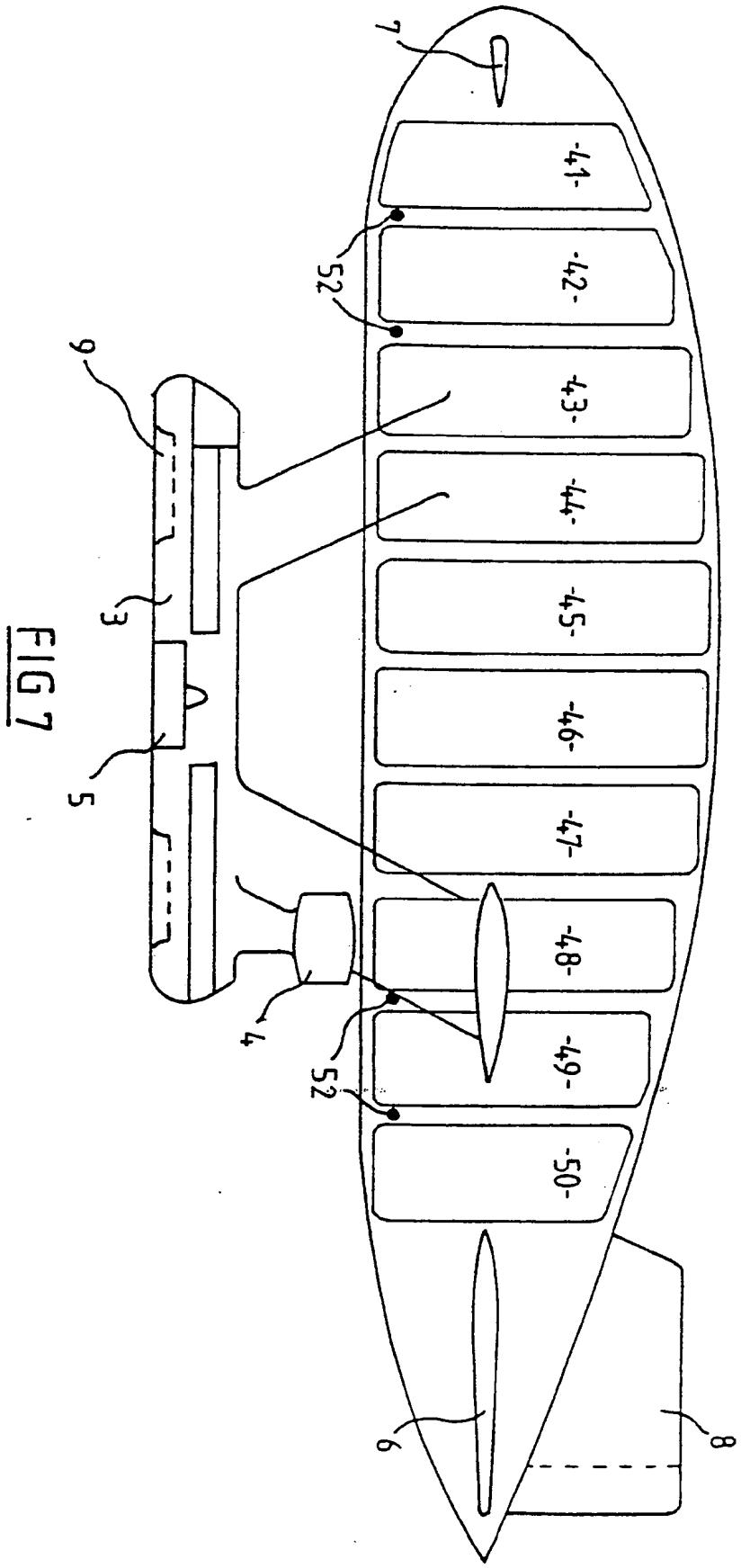


FIG 7

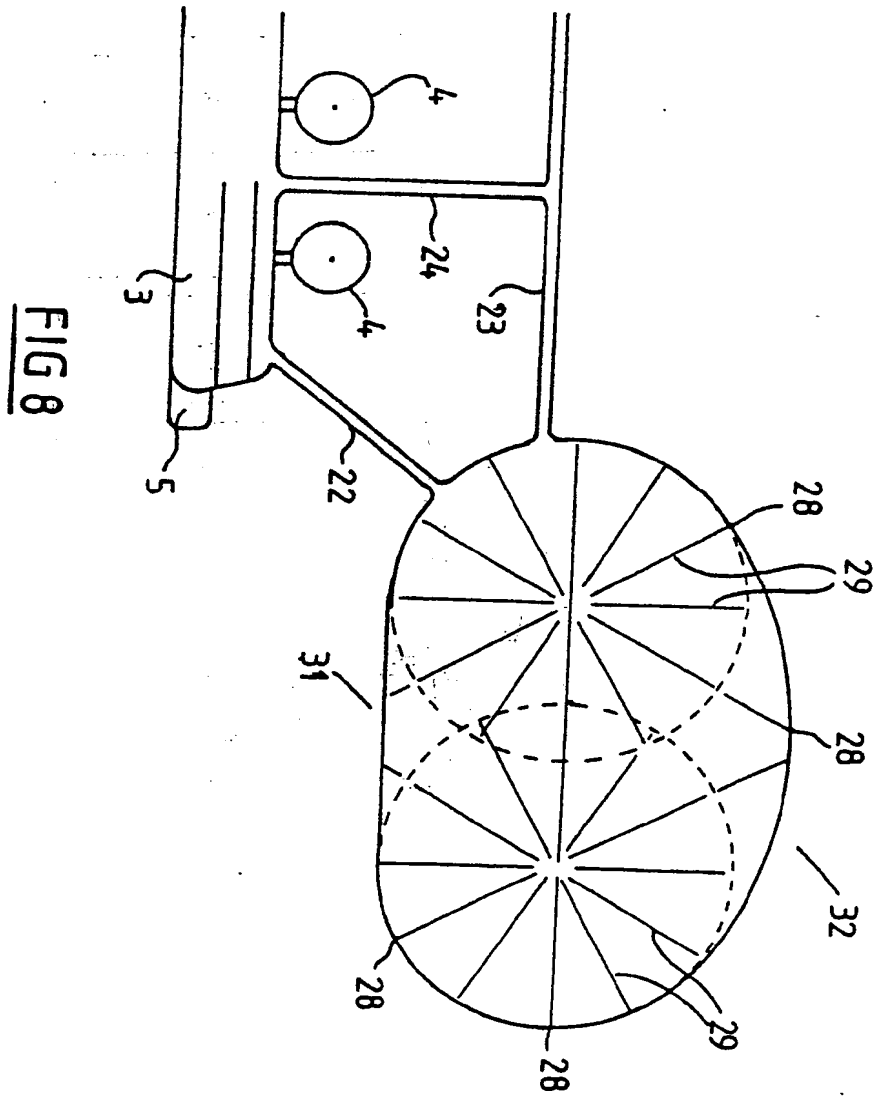
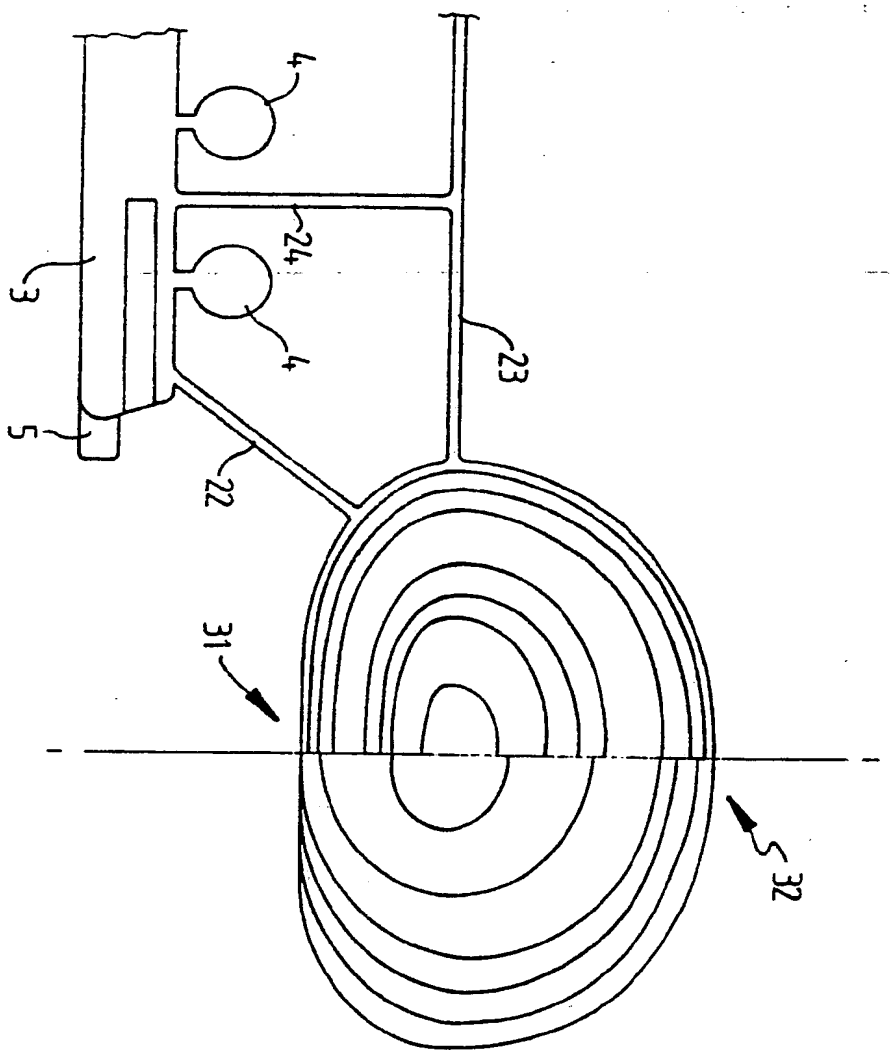


FIG 8

FIG 9



INTERNATIONAL SEARCH REPORT

International Application No PCT/AU 88/00440

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[4] B64B 1/06

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC	B64B 1/06, 1/08

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

AU: IPC as above
GB: Abridgments of Specifications Class 4 1855-1908, 1909-1915

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X,Y	AU,B, 485070 (54460/73) (MALVESTUTO) 17 October 1974 (17.10.74)	(1-23)
X,Y	US,A, 1808132 (DUERING) 2 June 1931 (02.06.31)	(1-23)
X,Y	US,A, 1657955 (BYLEK) 31 January 1928 (31.01.28)	(1-23)
X,Y	US,A, 1343428 (BERRY) 15 June 1920 (15.06.20)	(1-23)
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X,Y	FR,A, 535810 (ENLIND) 21 April 1922 (21.04.22)	(1-23)
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Y	GB,A, 1877/1896 (FRASER) 14 March 1896 (14.03.1896)	(14-18)
Y	GB,A, 10062/1904 (GLENDINNING) 2 February 1905 (02.02.05)	(14-17)

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"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
13 February 1989 (13.02.89)	23 FEBRUARY 1989 (23.02.89)
International Searching Authority	**Signature of Authorized Officer**
Australian Patent Office	G.M. COX

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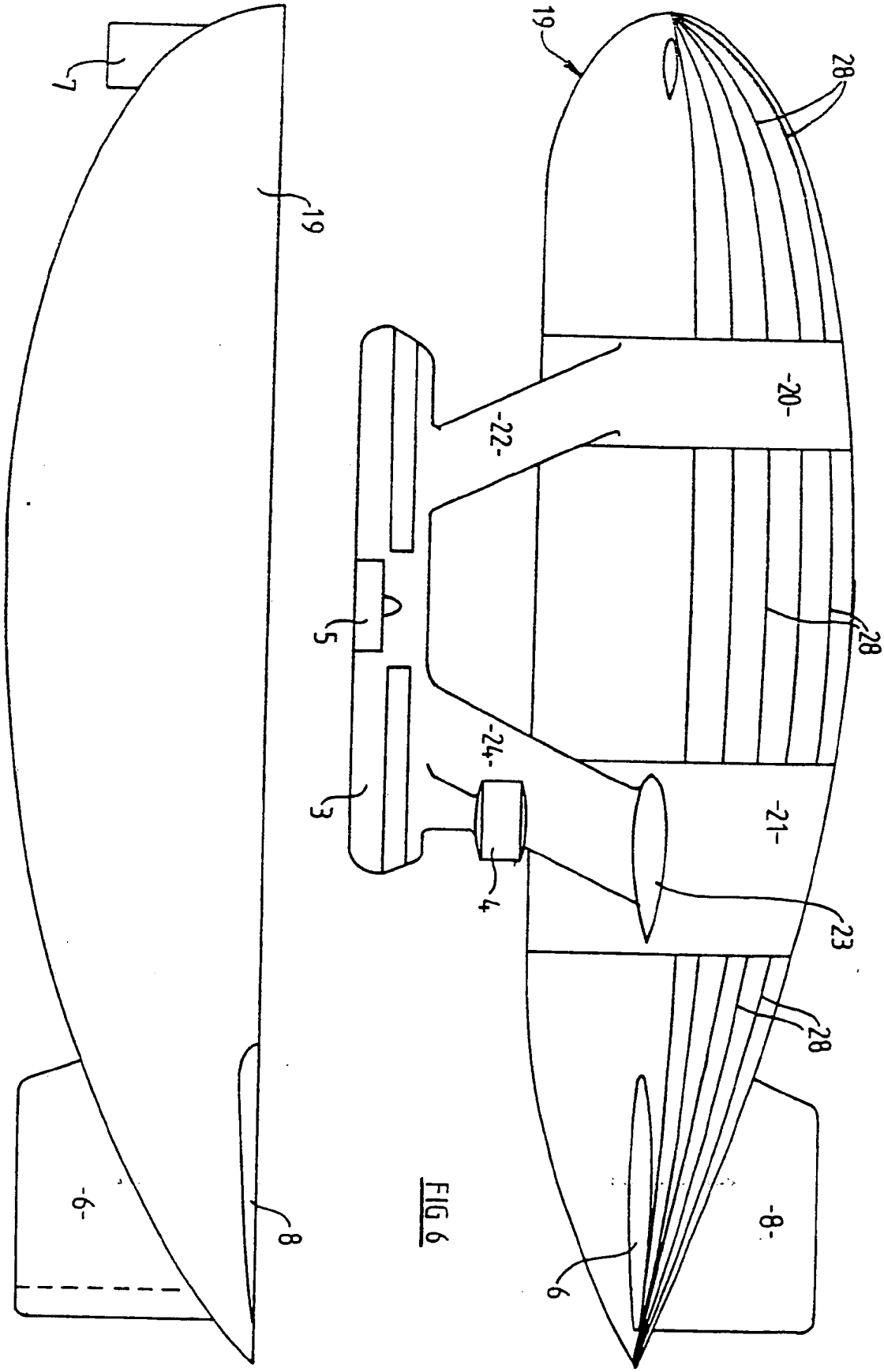


FIG 6

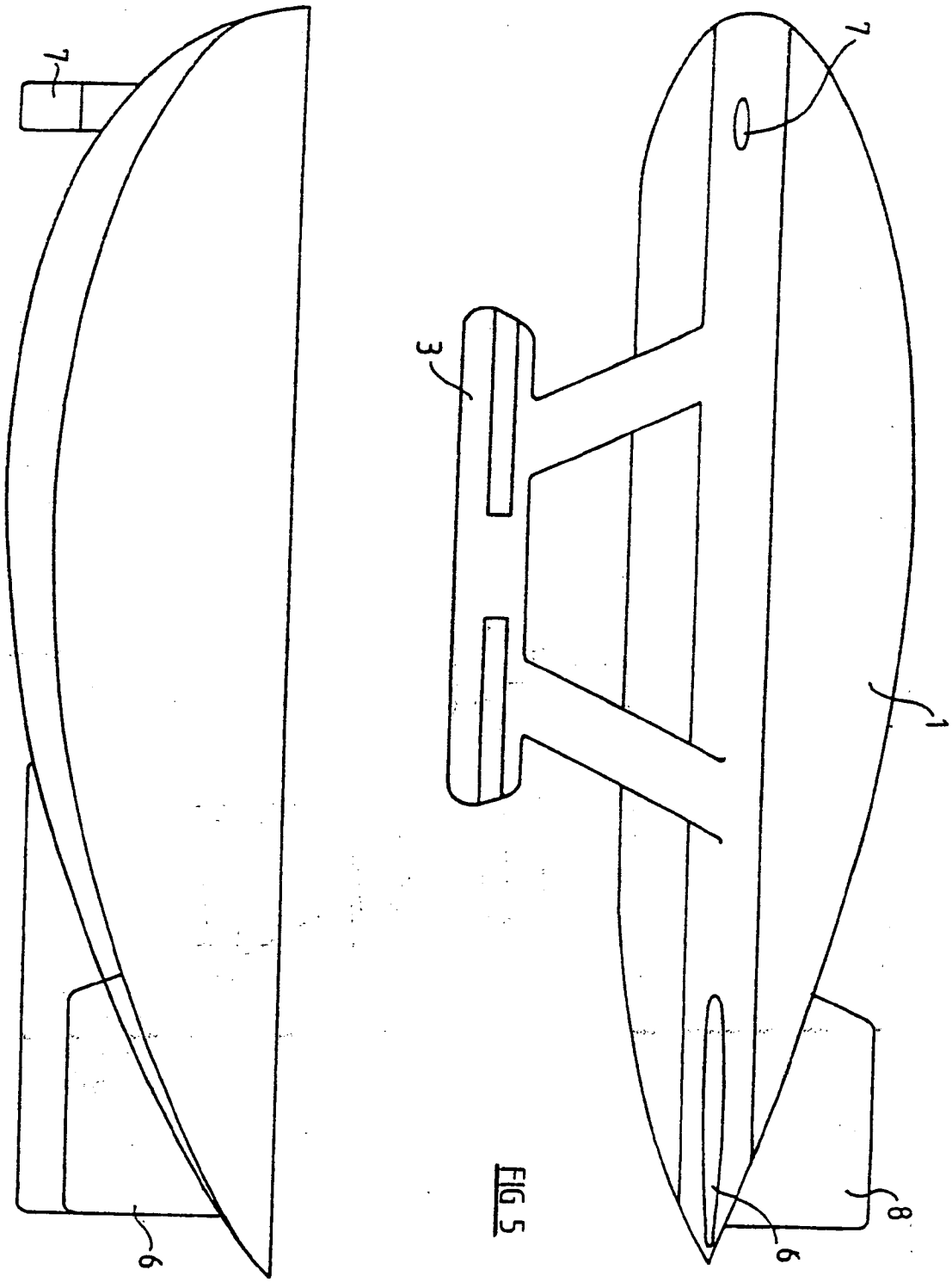


FIG 5

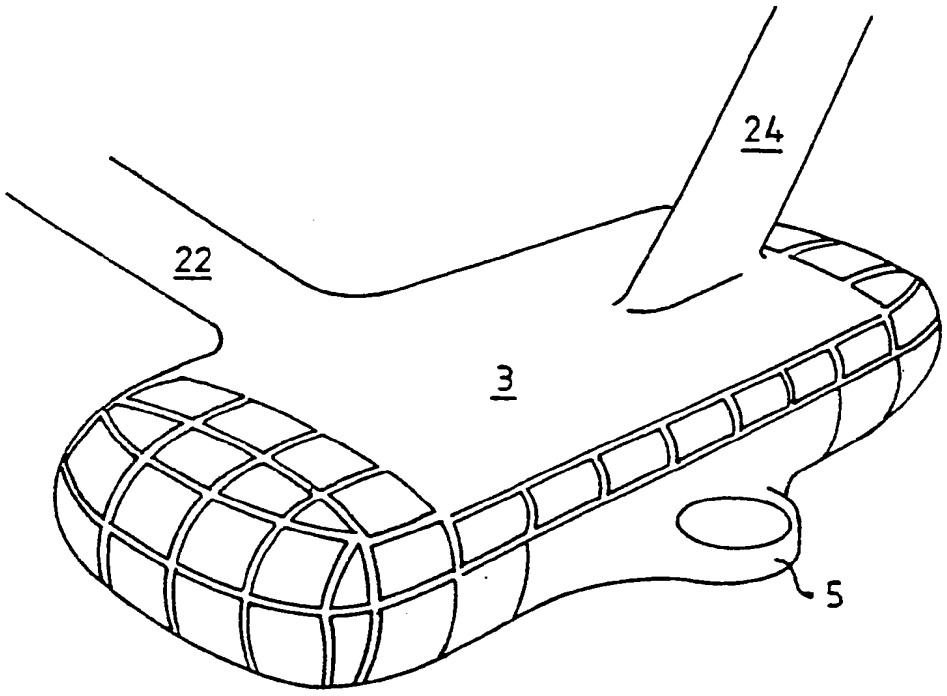


FIG.4A

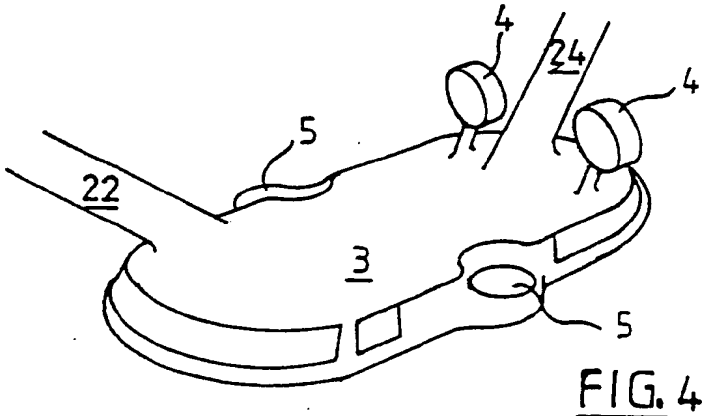


FIG.4B

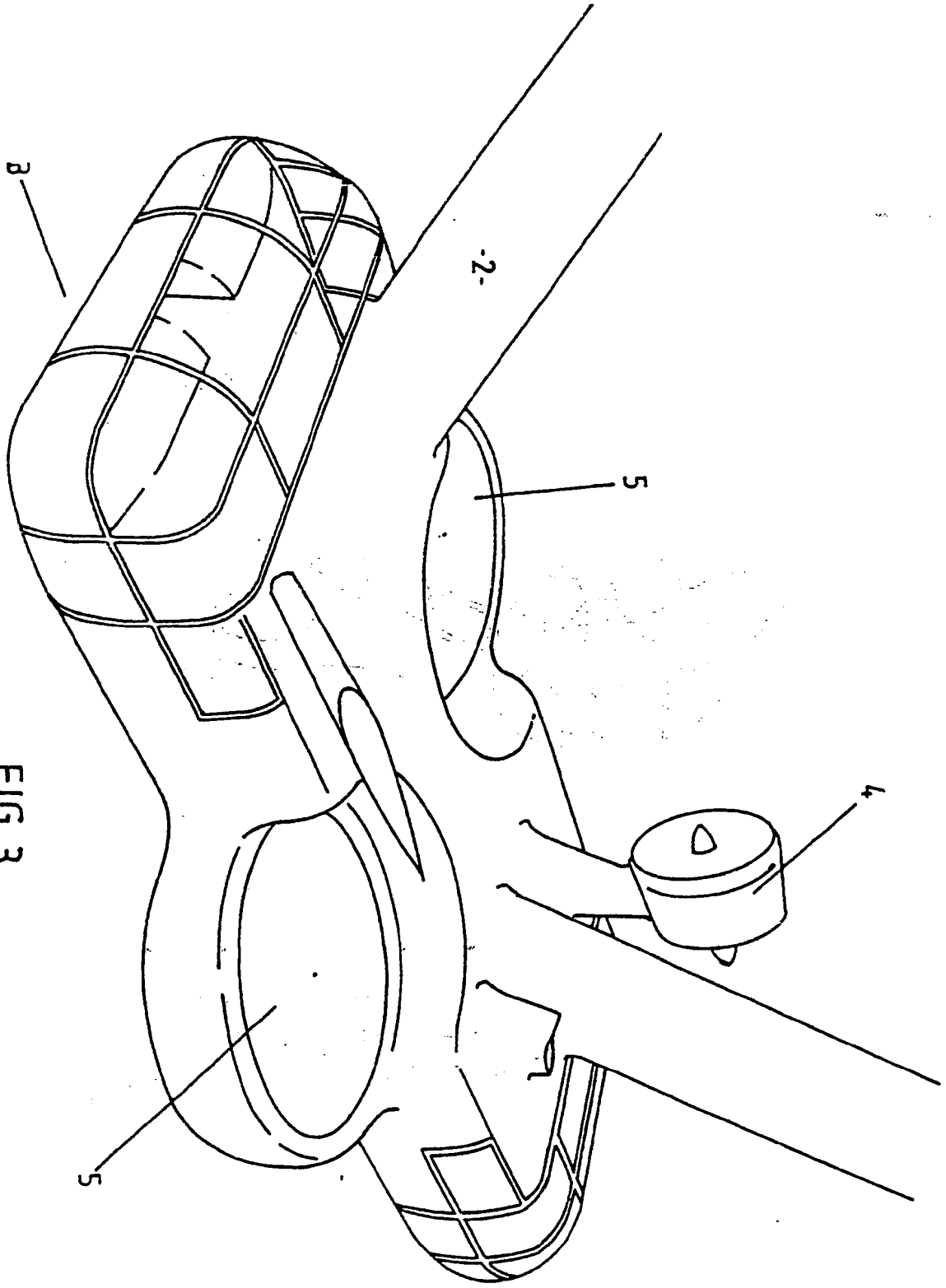


FIG 3

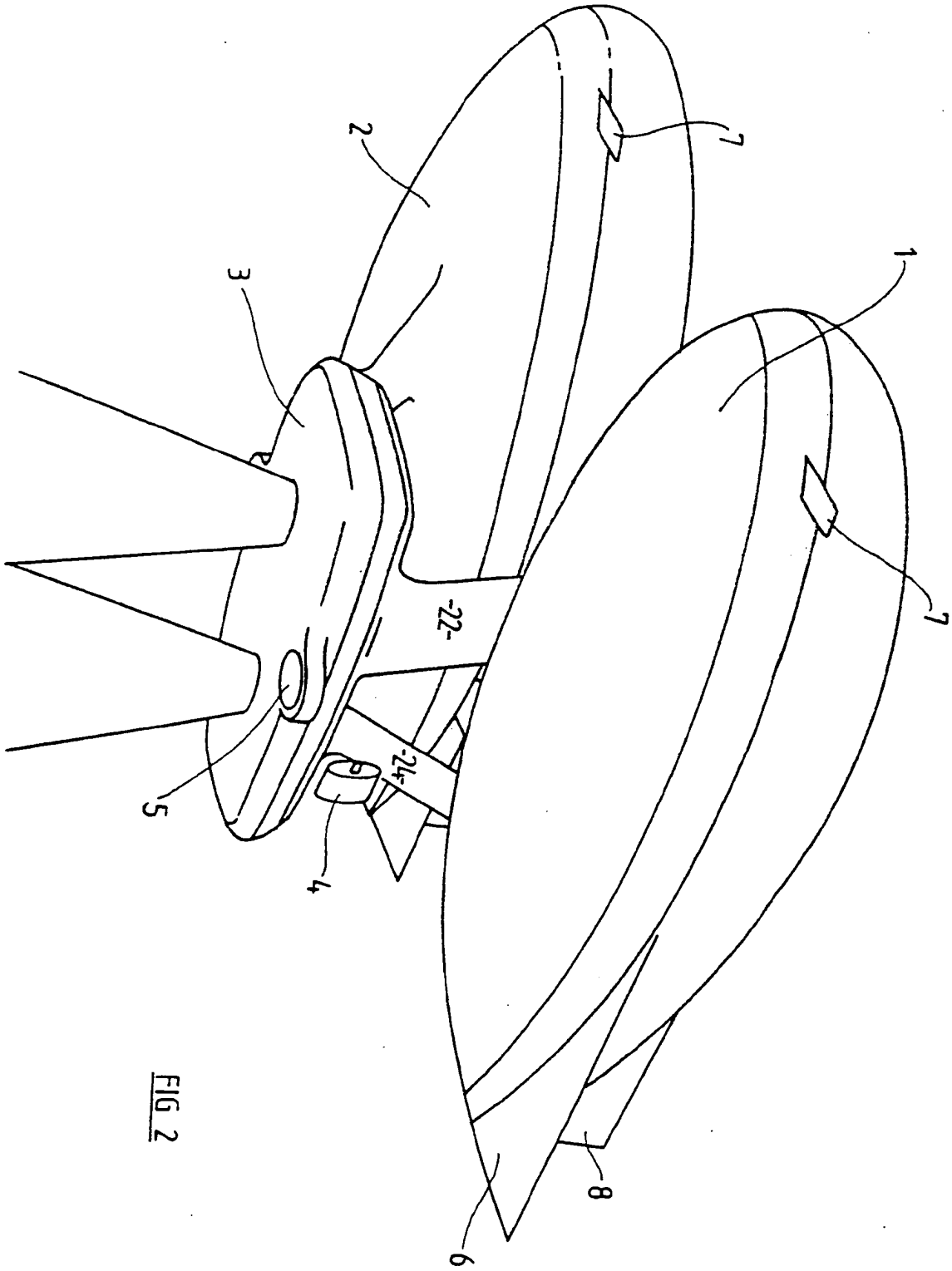
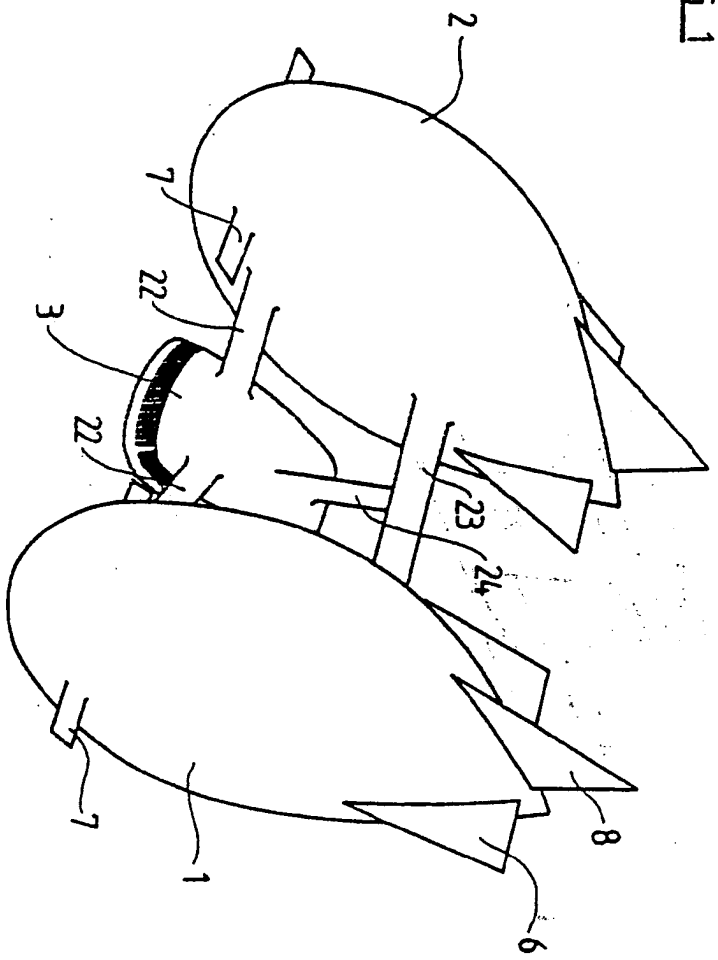


FIG 2

FIG_1



ANNEX TO THE INTERNATIONAL SEARCH REPORT ON
INTERNATIONAL APPLICATION NO. PCT/AU AU 88/00440

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Members		
AU 54460/73	AR 204158	CA 989373	CH 576369
	DE 2318022	ES 413589	FR 2180076
	GB 1421013	IL 41967	IT 983825
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